In examining the results of some of the experiments upon the effects of single masses of protecting metal on the sheeting, the author observed, that in some cases the corrosion seemed to increase with the distance from the protector. It became, therefore, necessary to investigate this circumstance, and to ascertain the extent of the diminution of electrical action in instances of imperfect or irregular conducting surfaces. Sir Humphry details several experiments in illustration of this inquiry, which prove that any diminution of protecting effect at a distance does not depend upon the nature of the metallic, but of the imperfect or fluid conductor. His experiments upon perfect and imperfect conductors led him to another inquiry, important in its practical relations, respecting the nature of the contact between the copper and the preserving metal. He found the protecting action prevented by the thinnest stratum of air, or the finest leaf of talc or dry paper; but the ordinary coating of rust, or a thin piece of moistened paper, did not impair it.

After some experimental details respecting the electro-chemical powers of metals in solutions excluded from air, Sir Humphry concludes his paper with practical inferences and theoretical elucidations arising out of its general details. Finding that in certain cases of imperfect connexion, the influence of the protector was weakened by distance, the author proposed that when ships with old sheathing were to be protected, a greater proportion of iron should be used, and if possible more distributed. The advantage of this plan was strikingly shown in the Semerang, which had been coppered in India in the year 1821, and came into dock, in the spring of 1824, covered with rust, weeds, and zoophytes; she was protected by four masses of iron, equal in surface to about one 80th of the copper, two of which were near the stern, and two on the bows. She made a voyage to Nova Scotia, and returned in January 1825; not, as was falsely reported, covered with weeds and barnacles, but remarkably clean and in good condition. After citing other instances of the perfect efficiency of the protectors, and adverting to the relative proportion which, in different circumstances, they ought to bear to the sheathing of the vessel, and to the most advantageous methods of applying them, the author concludes by observing upon the importance of selecting perfectly pure copper for the sheathing; of applying it smoothly and equably; and of using for its attachment nails of pure copper, and not of mixed metal.

On the Magnetism of Iron arising from its Rotation. By Samuel Hunter Christie, *Esq. M.A. of Trinity College, Cambridge; Fellow of the Cambridge Philosophical Society; of the Royal Military Academy. Communicated April* 20, 1825, *by* J. F. W. Herschel, *Esq. Sec. R.S.* Read May 12, 1825. [*Phil. Trans.* 1825, *p.* 347.]

The effects observed and described in this paper, although minute in themselves, appear, in the author's opinion, to point out a species of magnetic action not hitherto described. It had long been well

known that striking, twisting, or filing iron in different directions with regard to the magnetic axis, materially influenced its polarity; but it does not appear to have been remarked, that the simple rotation of iron in different directions has any such influence. This, however, the author has ascertained to be the case; and that the laws which govern this peculiar action are so regular, that there can remain no doubt of a corresponding regularity in their causes.

The attention of the author was first drawn to these phenomena by some apparent anomalies in the magnetic action of an iron plate on the compass, observed in the course of a different investigation. In order to avoid or allow for the disturbing influence of partial magnetism in the iron, it became necessary to attend minutely to the position of certain points in its circumference, which corresponded to the maxima and minima of this magnetism. It was then found that these points were not constant, but shifted their position as the plate was made to revolve in its own plane; or, in other words, that a plate which, in a given position, produced a certain deviation in a compass, no longer produced the same deviation after making an exact revolution in its own plane, although brought to rest, and every part of the apparatus restored precisely to its former place. It appeared from this that the revolution of the plate in its own plane had an influence on its power of deviating the needle independent of the partial magnetism of particular points in it; and the justice of this idea was proved by giving it a rotation in an opposite direction, when the effect on the directive power was also reversed.

The change produced by rotation in the directive power of the plate was found to be a maximum when its plane was parallel to the line of dip, or the magnetic axis, and at the same time as little inclined to the horizon as this condition would allow; but when the plane of the plate was parallel to the horizon, the effect was diminished in the ratio of 5 to 1; and when perpendicular to the horizon, and coincident with the magnetic meridian, was altogether destroyed.

The author having satisfied himself of the reality and constancy of this effect in different plates, and of the necessity of referring it to a peculiar agency of the earth's magnetic power on the molecules of the plate, proceeded to ascertain the laws, and measure the quantities of the *deviation* due to rotation (so he terms it) in various positions, and details a great number of experiments, with their numerical results arranged in the form of tables. From these he deduces the following general law; viz. That the deviation due to *rotation* in a *dipping-needle* "will always be such that the sides of the equator of such dipping-needle will deviate in a direction contrary to the direction in which the edges of the plate move; that edge, and the plate nearest to either edge of the equator, producing the greatest effect."

The results of this law, it may be here observed, are in many cases coincident with those of the following. Conceive the dipping-needle orthographically projected on the plate; then will the *deviation due*

to rotation of the projected needle *take place in a direction opposite to that of the rotation itself.*

The author then proceeds to a theoretical investigation of the effect of a plate of soft iron, having within it two poles developed in given positions, and acting (in addition to the usual magnetic action of soft iron,) on a needle of infinitely small dimensions in the plane of the plate. He refers the whole ordinary action of the iron to its centre, and supposes that this is *attractive* on both poles of the needle; but the extraordinary action, or that of the newly developed poles, he supposes to reside in them, and to be attractive or repulsive according as they act on the poles of the needle of the same or opposite names with themselves. On this hypothesis, assuming symbols for the coordinates of the plate's centre, the distances separating the newly developed poles in the plate, and the angle which the line joining them makes with the direction of the needle, &c. &c. deduce (from the known laws of magnetism) formulæ expressing the horizontal deviations of the needle: 1st, on the supposition of a rotation in one direction; 2ndly, on that of a rotation in the opposite; and 3rdly, in that of no rotation at all. From these, by comparing them with a few of the observations, he deduces numerical values for the constants of the formulæ, and then employs them to compute the deviations due to the rotation in all the rest. He regards the discrepancy between the calculated and observed results as in few cases larger than what he considers may be fairly attributed to error of observation, and that the theory above stated is at the least a general representation of what passes in fact; admitting, however, that it does not give the exact position of the point where the deviation due to the rotation vanishes, and suggesting partial magnetism in the iron plate used, as one mode of accounting for the difference. At all events, by an examination of the case on the ordinary supposition of induced magnetism in the iron, he shows that a greater coincidence between theory and fact would not result from that hypothesis than from the one here employed.

He then proceeds to inquire into the degree of permanence of the polarity thus produced in iron by rotation; from which inquiry it appears that (at least during twelve hours after the plate was brought to rest,) the influence of a single rotation had scarcely suffered any diminution. It appears also that the effect is so far from depending on the rapidity of the motion, that the plate can scarcely be made to revolve so slowly that the whole effect shall not be produced.

Lastly, by a slight change in the formulæ, the results of computation can be made to agree with observation, to a degree of exactness as near as can be wished. This change consists in the omission of certain terms introduced by the theory, and the author regards it as very possible so to modify the theory as to get rid of them.

The author closes this communication with an Appendix, comparing the magnetic effects produced by slow and rapid rotation. The result of the comparison is, that the forces exerted on the needle

during rapid rotation, are always in the same direction as those derived from the slowest rotation, and which continue to act after the rotation has ceased, but are greater in intensity; and that the former effects are such as might have been looked for from a knowledge of the latter.

Some Account of the Transit Instrument made by Mr. Dollond, *and lately put up at the Cambridge Observatory. Communicated April* 13, 1825. *By* Robert Woodhouse, *A.M. F.R.S.* Read May 19, 1825. [*Phil. Trans.* 1825, *p.* 418.]

The author in this paper first describes the operations by which the new transit instrument at the Observatory of Cambridge was approximatively placed, so as to allow of a meridian mark being erected on the distant steeple of Granchester church. He then enters into a more full consideration of the different methods proposed and employed by astronomers for executing the more delicate adjustments of the transit in general; he shows how the errors of collimation, level, azimuth, and the clock, may all be detected, and their values determined, by the resolution of certain equations of the first degree, constructed from observations of any three or more stars; but this method, though exact in theory, he reprobates in practice, and prefers making each adjustment separately and by the ordinary mechanical trials, as shorter, more effectual, and less troublesome. Mr. Woodhouse then describes a remarkable phenomenon presented to him by the transit in the course of his observations. He found that the line of collimation of the instrument deviated occasionally to the east or west of the centre of the meridian mark, without any apparent reason. At length, however, it was found that this was caused by the approach of the assistant's body to the lateral braces, placed for the purpose of steadying the instrument in an invariable position at right angles to its axis. The expansion of the brace nearest to him was found to thrust the axis of the telescope aside; and on the removal of the assistant, the equilibrium of temperature restoring itself, the deviation gradually disappeared. That this was the true cause, appeared by wrapping hot cloths round the alternate braces, by which the same effect was produced in an increased degree. Warned by these observations, Mr. Woodhouse ordered a proper apparatus to be provided, to defend the braces from the sun's rays, during the meridian passage of that luminary.

On the fossil Elk of Ireland. By Thomas Weaver, *Esq. Member of the Royal Irish Academy, of the Royal Dublin Society, and of the Wernerian and Geological Societies.* Read May 19, 1825. [*Phil. Trans.* 1825, *p.* 429.]

Mr. Weaver's principal object in this paper is to prove that the remains of the gigantic elk, which have been found in various parts of Ireland, are not of antediluvian origin, but that the animal lived